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# Fabrication of Photo-responsive Nanospheres as Vehicles for Controlled Drug Delivery

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My project was to fabricate the Pan-stat-P4VP polymer nanosphere and apply its photo-responsive characteristic to medical field. The first step of my project was to design and synthesize Pan-stat-P4VP random copolymer which was composed of 4-vinylpyridine and acrylonitrile. Then, after obtaining the molecular structure, these two monomers were polarized using RAFT polymerization. The fluorescent dye: MY (metanil yellow) and SAS (sodium antraquinone -2 –sulfonate) was added to the polymer by slow titration. Then, the copolymer with fluorescent dyes used self-assembly to form the hollow nanosphere. [1]It was a kind of deformable nanosphere, and would react to the polarized linear laser light. After photo-activation, the round shape nanosphere would turn to olive shape. [2] Due to the hollow structure and deformation, it could be a potentially efficient drug delivery vehicle. My question was how much the olive shape copolymer nanosphere would change the rate of entering the living cell membrane compared to the normal round shape nanosphere. I used E. coli cells for the membranes, and then, the florescent azo dye could help me to observe the rate directly under the fluorescent microscope. My final goal in this summer was to observe the speed change between the original nanosphere and photo-activated nanosphere. In the future, I hope I could control the rate of medicine entering the cells by using this photo-responsive characteristic. If the photo-responsive characteristic did speed up the diffusion rate, ill cells in our body could absorb the medicine more or more quickly by using this nanosphere polymer. It could be applied in various diseases such as cancer or leukemia.

I successfully fabricated the photo-responsive nanosphere polymer with fluorescent dye by self-assembly. But the florescent dye (MY and SAS) used for this experiment did not work well as expected. The computer showed that the fluorescent light from the nanospheres was not able to be captured, which should be clearly shown on the screen in theory. Accordingly, the diffusion rate could not be observed directly under the fluorescent microscope. Then, for finding the reason, on one hand, I used polarized laser treatment to exam the viability of E.coli. The result under the optical microscope showed that E.coli was still moving after one-hour light treatment. It meant E.coli could survive for at least one hour with the polarized laser treatment at room temperature. Therefore, I could verify that the viability of the E.coli was not the main reason causing the failure. On the other hand, I observe the dye directly under florescent dye. It did not work as a strong florescent dye as expected. Hence, for my future research, I need to do other experiments to find why the florescent dye did not work well. In the meantime, a better florescent dye need to be found in the future experiments. Also, the chemical environment (e.g. pH value, temperature, the concentration of the dye, etc.) may matter in this case. I will find the best chemical environment for the future experiments as well.

**REFERENCES:**

[1] Jin, Cheng, Taoran Zhang, Lingyu Wang, Meiying He, Bo Jian, Dequan Xiao, Qinjian Yin. "Photoinduced Deformation of Hollow Nanospheres Formed by the Self-Assembly of Amphiphilic Random Copolymers and Small Azo Molecules." RCS Advances 4.86 (2014): 45890. Print.

[2] Jin, Cheng, Taoran Zhang, Fangzhuan Liu, Lingyu Wang, Qinjian Yin, and Dequan Xiao. "Fabrication of Size Controllable Polymeric Hollow Nanospheres Containing Azo Functional Groups via Ionic Self-assembly." RCS Advances 4.16 (2014): 8216. Print.